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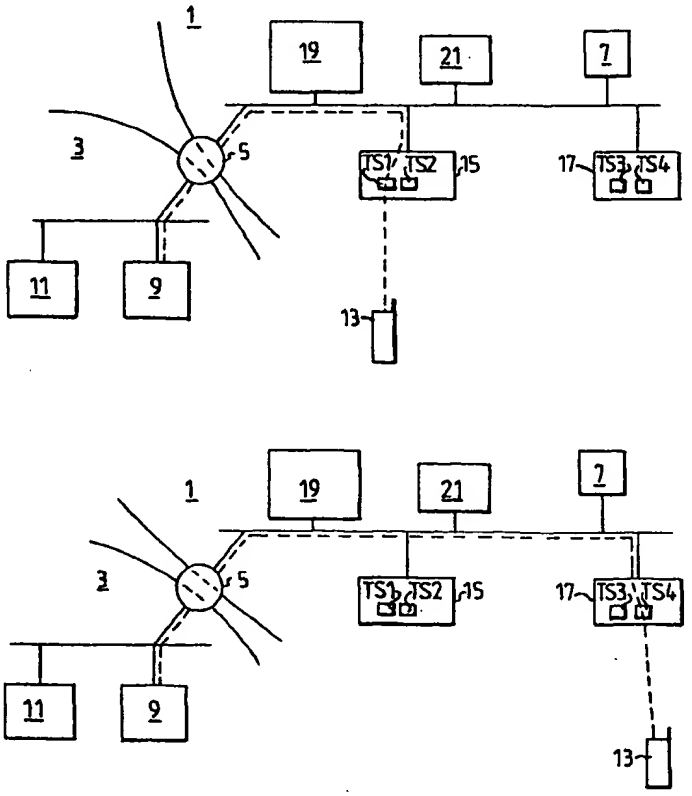
(57) Abstract

The mobility of terminals connected to an IP network through a radio interface is enabled by assigning a temporary IP address and a temporary address according to a protocol on a level below the IP level, such as a MAC address, to the mobile terminal, by which the mobile terminal may be identified for the duration of a connection, and storing said addresses in the base transceiver station. An apparatus, effectively an RNC, that will enable mobility in a packet switched communication network, is also disclosed, comprising a table of unique addresses on a level lower than the IP level, that may be used to identify a mobile terminal connected to the network temporarily for the duration of a connection, and means for dynamically assigning IP addresses that may be used to identify a mobile terminal connected to the network temporarily for the duration of a connection.



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METHOD AND APPARATUS IN A COMMUNICATION NETWORK

Technical Field

The present invention relates to data communication and more specifically to the mobility of terminals in packet switched networks, such as Internet Protocol (IP) networks.

Description of Related Art

Such networks are mainly developed for stationary terminals connected to the network by wired connections. Mobile terminals may be connected by use of base transceiver stations, but to achieve true mobility functions are required for handling i.a. roaming and handover in the network.

For example, the H.323 recommendation from the Telecommunication Standardization Sector of the International Telecommunication Union (ITU-T) specifies terminals and equipment for multipoint teleconferencing and multimedia communication services. H.323 specifies how to interwork with existing network and equipment. The H.323 recommendation does not specify or recommend functionality, architecture, protocols etc. for including mobile terminals.

The Mobile-IP working group of the Internet Engineering Task Force (IETF) is currently working on a standard for mobile IP. The main goals of the Mobile IP standard are:

The system shall work within the TCP/IP protocol suite and provide Internet-wide mobility.

The system shall be transparent to higher layer protocols and allow hosts to keep their IP addresses as they migrate.

No changes shall be required of non-mobile hosts and routers.

It should be noted that a mobile terminal in this context does not mean a mobile terminal having a radio interface but a fixed terminal or user that changes its point of a attachment from one fixed network to another.

A solution which supports mobility of terminals connected to an IP network via a radio interface, and even handover, is disclosed in US 5, 371 738. According to this solution bridges are used for the connection between the mobile terminals and the IP network.

The main problem with this solution is that it only works for terminals that have an IP address and a Media Access Control (MAC) address. IP addresses are used to identify terminals connected to an IP network, and may be allocated dynamically or permanently. MAC addresses, on the other hand, are unique to each terminal. Each manufacturer of data terminals has a number series from which a number is taken to identify each individual terminal.

Many terminals, for example, mobile telephones, do not have such addresses, and therefore, the solution cannot be used.

In this context, a base transceiver station may be seen as a bridge, with the mobile terminal on one side and the remaining network on the other.

The use of bridges has several advantages. A bridge interconnecting two Local Area Networks (LANs) learns where a particular MAC address is connected and only directs calls to terminals found on the other side of the bridge through it. A bridge is also insensitive to higher level protocols. It monitors all traffic on the subnetworks that it links, reading every packet, but only for the MAC layer source and destination address. On this basis alone the bridge determines the subnetwork from which the packet is coming and to which it is going. This means that a bridge can interconnect networks according to higher-level protocols that are incompatible.

Routers are also used to interconnect LANs, but they are protocol dependent and work on a higher level than bridges.

Object of the Invention

It is therefore the object of the present invention to improve the mobility of terminals connected to an IP network through a radio interface.

Summary of the Invention

The object is achieved according to the invention by a method for establishing a connection to or from a mobile terminal in a packet switched communication network, said mobile terminal being connectable to said network by means of a base transceiver station, said method comprising the steps of

assigning a temporary IP address and a temporary address according to a protocol on a level below the IP level, to the mobile terminal, by which the mobile terminal may be identified for the duration of the connection, and storing said addresses in the base transceiver station;

The object is also achieved according to the invention by an apparatus for use in a packet switched communication network, said apparatus being adapted to monitor connections to mobile terminals in the communication network, said apparatus comprising:

a table of unique addresses on a level lower than the IP level, that may be used to identify a mobile terminal connected to the network temporarily for the duration of a connection;

means for dynamically assigning IP addresses that may be used to identify a mobile terminal connected to the network temporarily for the duration of a connection.

Thus, the method and apparatus according to the invention enables the dynamic allocation of IP addresses and lower-level addresses to a mobile terminal while such addresses are needed, that is, while the mobile terminal is connected to the network. The lower-level address may be, for example, a MAC address, as described above.

According to a first preferred embodiment the method according to the invention further comprises the steps of
initiating the assignment of the IP and lower-level addresses by requesting a connection to the mobile terminal from another terminal in the network; and
establishing a connection to the mobile terminal through the base transceiver station, using the temporarily assigned IP and lower-level addresses to identify the mobile terminal.

These steps are carried out when a terminal in the network requests a connection to the mobile terminal.

According to a second preferred embodiment the method according to the invention further comprises the steps of
initiating the assignment of the IP and lower-level addresses by requesting a connection from the mobile terminal to another terminal in the network
establishing a connection to the mobile terminal through the base transceiver station, using the temporarily assigned IP and lower-level addresses to identify the mobile terminal.

These steps are carried out when a mobile terminal requests a connection to another terminal in the network.

The apparatus specified above may also comprise a table of IP addresses that may be assigned temporarily to terminals connected to the network.

A packet switched network is also disclosed, comprising at least one apparatus according to the above. The network may also comprise a node comprising a number of IP addresses that may be used by the apparatus according to the invention.

According to the invention, the base transceiver station may be seen as a variant of a bridge, but only from the network side, since the mobile station which it connects to the network does not in itself act as a subnetwork in the way a terminal having an IP address and a MAC address would. It therefore provides the above mentioned advantages associated with bridges.

The solution according to the invention is independent of the type of terminal and the radio protocol used. It can be applied in, for example, in GSM systems, Bluetooth and DAMPS, and in any other type of packet switched communication networks.

Brief Description of the Drawings

Figure 1A is an overview of a data network according to the invention;

Figure 1B illustrates the situation in the data network shown in Figure 1A after a handover has been performed according to the invention;

Figure 2 is a flow chart of the procedure for calling a mobile terminal in a data network according to the invention;

Figure 3 is a flow chart of the procedure of making a call from a mobile terminal in a data network according to the invention.

Figure 4 is a flow chart of the handover procedure according to the invention;

Detailed Description of Embodiments

Figure 1A shows a network according to an embodiment of the invention. The network may comprise several subnetworks 1, 3 connected to each other by means of routers 5. A number of stationary terminals 7, 9, 11 may of course be connected to each of the subnetworks 1, 3 in ways well known in the art.

As common in the art, the router 5 keeps a table of IP addresses and MAC addresses found in each subnetwork to facilitate the routing between subnetworks 1,3. There-

fore, the establishment of connection between subnetworks connected by a router requires that both the involved terminals has both an IP address and a MAC address.

Also, one or more mobile terminals 13, for example, mobile telephones may be connected. For connecting such terminals to the network, base transceiver stations 15, 17 are used. The base transceiver stations are connected to the respective subnetwork and provide radio connection to the mobile terminals. The subnetwork 1 also comprises a Radio Network Controller (RNC) 19. Generally, a mobile terminal is identified in a base transceiver station and an RNC by means defined by the radio standard used. For example, in GSM the International Mobile Subscriber Identity (IMSI) is used. The RNC reserves a channel for the mobile terminal when a connection is needed. The nature of the channel also depends on the standard used, for example, in GSM systems it will be a time slot, in FDMA systems it will be a frequency, etc.

In Figures 1A and 1B, each base transceiver station 15,17 is shown with two time slots TS1, TS2 and TS3, TS4, respectively. A connection from the mobile terminal 13, to the first terminal 9 in the other subnetwork is shown, using the first time slot TS1 in the first base transceiver station 15.

For this to work, the mobile terminal 13 must have a MAC address and an IP address. According to the invention, the RNC 19 comprises a table of MAC addresses that may be dynamically allocated to terminals when needed. This means that a MAC number series must be reserved for each RNC according to the invention. The subnetwork also comprises a Dynamic Host Configuration Protocol (DHCP) server 21 which, among other things, comprises a from of IP addresses that may be borrowed by the RNC for temporary allocation according to the invention. Preferably, the RNC 19 keeps a number of idle IP addresses that may be dynamically allocated to terminals when needed, to avoid the delay caused by requesting a new IP address

each time a call is made. Alternatively, the whole IP address table may be kept in the RNC 19.

When needed, a MAC address and an IP address are associated with each time slot, or effectively each mobile terminal, so that it can be addressed by other terminals. According to the invention, the mobile terminal is not aware of its own MAC and IP addresses. These addresses are only used by the network to identify the mobile terminal as long as the connection lasts.

The RNC 19 supervises each connection. When the RNC determines that the mobile terminal is moving out of the area covered by the base transceiver station to which it is currently connected and into the area covered by another base station, it orders a handover by informing the new base station that it should take over the connection to the mobile terminal 13. The RNC 19 informs the new base station about the MAC address and IP address that have been dynamically allocated to the mobile terminal 13.

Figure 1B shows the situation after the handover has been completed. The connection from the mobile terminal 13 to the terminal 9 in the other subnetwork 2 now only goes through the second base station 17.

When the connection through the second base station has been established, the associations to the MAC and IP addresses are removed in the first base station. According to the GSM standards, the associations are kept for a period of time after the handover, so that if the handover fails, the connection can be moved back to the first base station.

If a new handover is needed it is performed in the same way.

Figure 2 shows the procedure for making a call to a mobile terminal 13 in the data network according to the invention.

Step S21: An incoming call for the mobile terminal 13 is detected by the RNC 19. The call may be made from a terminal in the same subnetwork or in another subnetwork.

Step S22: The RNC 19 retrieves an IP address and a MAC address to be dynamically allocated to the mobile terminal 13. According to the invention the RNC 19 comprises a table of MAC addresses that may be used for this purpose. The IP addresses are usually found in the DHCP server 21.

Step S23: The RNC 19 informs the BTS 15 about the MAC and IP addresses that have been dynamically allocated to the mobile terminal 13 and orders the BTS 15 to set up a connection to the mobile terminal 13 using these MAC and IP addresses to identify the mobile terminal 13 and to establish a connection to it on a specific time slot.

Step S24: The connection is set up and data is transmitted and routed.

Figure 3 shows the procedure for making a call from a mobile terminal 13.

Step S31: The mobile terminal 13 requests a connection by signalling to the RNC 19 via a BTS 15.

Step S32: The RNC 19 allocates an IP address and a MAC address to the BTS 15. These addresses will be dynamically allocated to the channel on which the mobile terminal 13 is to be connected. According to the GSM standard, this will be a different channel from the one used by the mobile terminal to signal to the RNC 19. According to other standards, the same channel may be used.

Step S33: The connection is established. In the connection the mobile terminal 13 is identified by the dynamically allocated IP and MAC addresses.

Step S34: Data is transmitted and received until the connection is ended.

Figure 4 is a flow chart of the handover procedure according to the invention. When the procedure starts, the mobile terminal is connected to another terminal 9 in the network as shown in Figure 1A, that is, through the first BTS 15.

Step S41: The mobile terminal moves into an area covered by another BTS 17.

Step S42: The RNC 19 informs the new BTS 17 about the MAC and IP addresses that have been dynamically allocated to the mobile terminal 13 and orders it to take over the communication with the mobile terminal 13 on a specific time slot TS4.

Step S43: The new BTS 17 establishes a connection to the mobile terminal 13.

Step S44: When the connection through the new BTS 17 has been established, the mobile terminal 13 signals "handover completed" to the RNC 19 through the new BTS 17.

Step S45: The RNC 19 orders the old BTS 15 to remove the associations to the MAC and IP addresses. This is the situation resulting from the handover, as shown in figure 1C.

If the terminal moves again so that another handover is needed, it is performed in the same way.

Claims

1. A method or establishing a connection to or from a mobile terminal in a packet switched communication network, said mobile terminal being connectable to said network by means of a base transceiver station, **characterized** by the steps of
   - assigning a temporary IP address and a temporary address according to a protocol on a level below the IP level, to the mobile terminal, by which the mobile terminal may be identified for the duration of the connection,
   - storing said addresses in the base transceiver station;

2. A method according to claim 1, further comprising the steps of
   - initiating the assignment of the IP and lower-level addresses by requesting a connection to the mobile terminal from another terminal in the network;
   - establishing a connection to the mobile terminal through the base transceiver station, using the temporarily assigned IP and lower-level addresses to identify the mobile terminal.

3. A method according to claim 1, further comprising the steps of
   - initiating the assignment of the IP and lower-level addresses by requesting a connection from the mobile terminal to another terminal in the network
   - establishing a connection to the mobile terminal through the base transceiver station, using the temporarily assigned IP and lower-level addresses to identify the mobile terminal.

4. A method according to any one of the claims 1, 2 or 3, wherein the IP and lower-level addresses are assigned by an RNC in the communication network.

5. An apparatus for use in a packet switched communication network, said apparatus being adapted to monitor connections to mobile terminals in the communication network, **characterized** in that it comprises

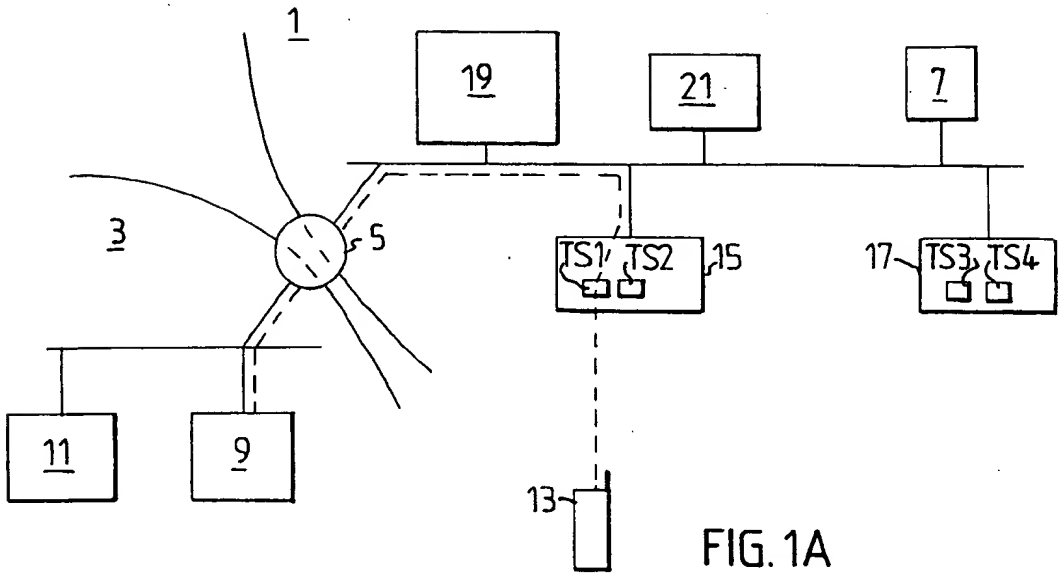
a table of unique addresses on a level lower than the IP level, that may be used to identify a mobile terminal connected to the network temporarily for the duration of a connection;

means for dynamically assigning IP addresses that may be used to identify a mobile terminal connected to the network temporarily for the duration of a connection.

6. An apparatus according to claim 5, wherein that said table of lower-level addresses comprises MAC addresses.

7. A packet switched network characterized in that it comprises at least one apparatus according to claim 5 or 6.

8. A network according to claim 6, further comprising an apparatus comprising a table of IP addresses that may be assigned temporarily to terminals connected to the network.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TS1
TS2
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TS3
TS4
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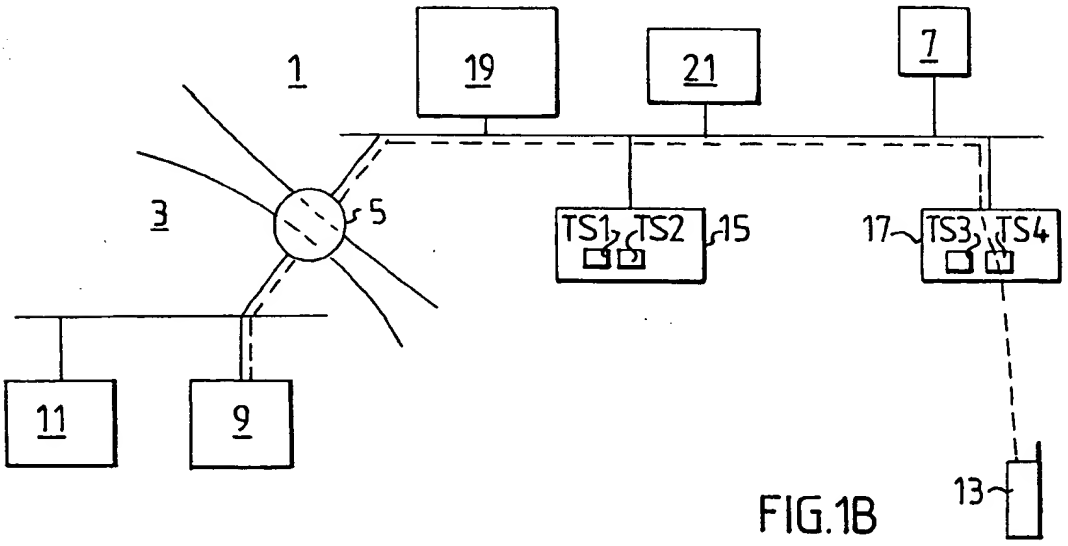
FIG. 1A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TS4
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FIG. 1B

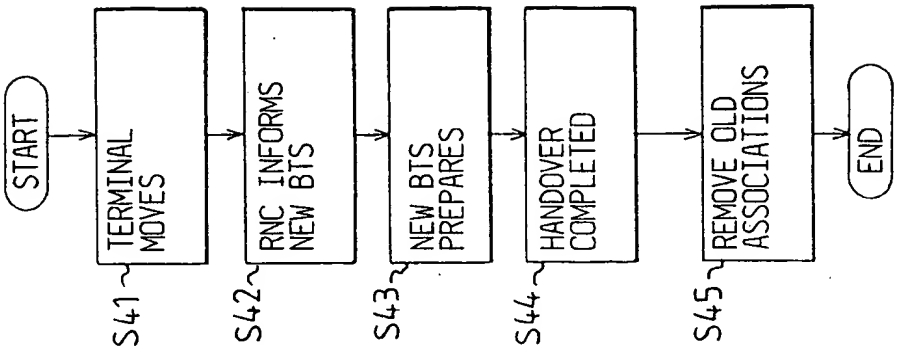

FIG.4

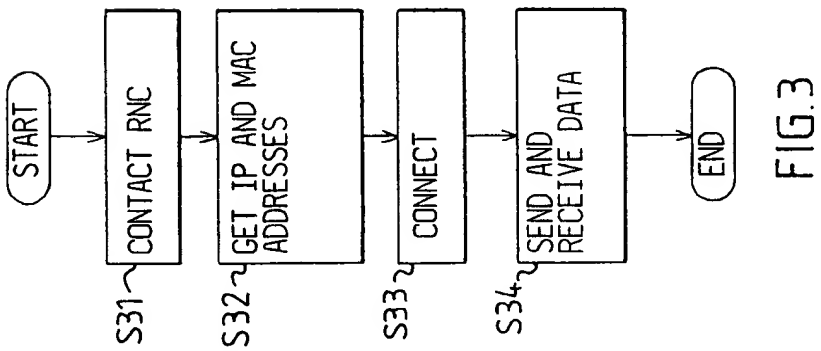

FIG.3

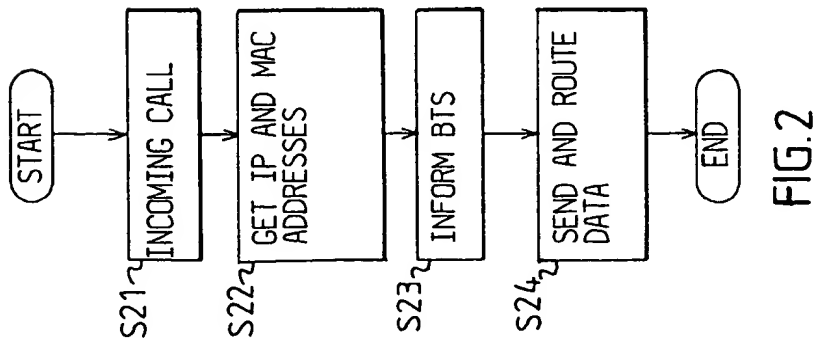

FIG.2

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 12/56
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9840990 A1 (NOMADIX, LLC), 17 Sept 1998 (17.09.98), page 7, line 33 - page 8, line 13, abstract --	1-8
A	EP 0483547 A1 (INTERNATIONAL BUSINESS MACHINES CORPORATION), 6 May 1992 (06.05.92), column 6, line 50 - column 7, line 32, abstract --	1-8
A	WO 9748210 A1 (BELL COMMUNICATIONS RESEARCH, INC.), 18 December 1997 (18.12.97), page 5, line 13 - page 6, line 26 --	1-8

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		JP 2516291 B	24/07/96
		JP 4227149 A	17/08/92
		US 5159592 A	27/10/92
WO 9748210 A1	18/12/97	NONE	